CLAIMS

What is claimed is:

1. A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over two outgoing links, the data payload having a given format and protocol, the system comprising

a route generator for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes,

an adder for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given one of the nodes for the data payload and the header, the format and protocol of the data payload being independent of the format and protocol of the header,

a detector for detecting the multicast information at the given one of the nodes to determine two switch control signals with reference to the multicast information as the data payload and the header propagate through the optical network,

an optical splitter for splitting the optical signal into two split optical signals,

a selector for selecting two local routes through the given one of the nodes in correspondence to the two switch control signals,

an optical switch having input ports and output ports wherein one of the split optical signals couples to a first input port and the second of the split optical signals couples to a second input port, and wherein one of the outgoing links couples to a first output port and the second of the outgoing links couples to a second output port, and

a switch controller, coupled to the optical switch and responsive to the two switch control signals, for switching the optical switch in response to the multicast information to optically couple the first input port with the first output port and the second input port with the second output port,

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload,

the detector further comprising

a measurement device for concurrently measuring the header signals to produce a header selection signal,

a second selector, coupled to the measurement device, for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals, and

a processor, responsive to the incoming optical signal, for detecting the multicast information and for deleting the header signals and recovering only the data payload,

the system further comprising

a header generator, responsive to the selector, for determining a new active header signal conveying the multicast information, and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

2. The system as recited in claim 1 wherein the adder includes a generator for generating a baseband header composed of a plurality of sub-headers wherein each of the sub-headers conveys a subset of the multicast information and each of the sub-headers determines one of the switch control signals.

3. The system as recited in claim 2 further comprising

a local oscillator, and

a mixer, responsive to the local oscillator and to the baseband header, for mixing the baseband header with the local oscillator to produce a frequency-shifted baseband header.

4. The system as recited in claim 3 further comprising a combiner, responsive to the mixer, for combining the data payload at baseband with the frequency-shifted baseband header to produce a composite baseband signal.

5. The system as recited in claim 4 further including

a laser source, and

an optical modulator, responsive to the laser source and to the combiner, for optically modulating the composite baseband signal with the laser source to produce the optical signal.

6. The system as recited in claim 1 further including an opto-electrical converter for opto-electrically converting the optical signal to an electrical header conveying the active header signal.

7. The system as recited in claim 6 wherein the processor includes a demodulator for demodulating the electrical header to obtain a demodulated active header signal.

8. The system as recited in claim 7 wherein the processor further includes a demodulator for detecting the multicast information in the demodulated active header signal.

9. The system as recited in claim 8 wherein the processor further includes a reader for reading the header information to produce the switch control signals.

10. The system as recited in claim 9 wherein reader includes means for inputting the multicast information to a content-addressable memory to produce the switch control signals.

11. The system as recited in claim 1 further including means for opto-electrically converting the optical signal to an electrical header, and wherein measurement device includes a down-converter for down-converting the electrical header to a plurality of intermediate frequency signals indicative of the header signals.

12. The system as recited in claim 11 wherein down-converter includes

means for locally generating the plurality of sub-carrier frequencies, and

a multiplier for multiplying the electrical header by the plurality of local sub-carrier frequencies to produce the plurality of intermediate frequency signals.

13. The system as recited in claim 12 further including means for envelope detecting each of the intermediate frequency signals to concurrently produce a plurality of envelope-detected signals.

14. The system as recited in claim 13 further including means for concurrently threshold detecting each of the envelope-detected signals to produce a plurality of decision signals.

15. The system as recited in claim 14 further including means for inputting the plurality of decision signals to a logic circuit to produce the header selection signal.

16. The system as recited in claim 1 wherein adder includes a generator for generating a baseband header composed of two sub-headers wherein each of the sub-headers conveys a subset of the multicast information and each of the sub-headers determines one of the switch control signals.

17. The system as recited in claim 16 further including

a local oscillator, and

a mixer for mixing the baseband header with the local oscillator to produce a frequency-shifted baseband signal.

18. The system as recited in claim 17 further including a combiner for combining the data payload at baseband with the frequency-shifted baseband signal to produce a baseband optical signal.

19. The system as recited in claim 18 further including

a laser source, and

an optical modulator for optically modulating the baseband optical signal with the laser source to produce the optical signal.

20. The system as recited in claim 19 wherein the header is conveyed by a distinct sub-carrier frequency occupying a frequency band above the data payload, and the detector includes

means for detecting the sub-headers to obtain the multicast information, and

means for processing the multicast information to obtain the two switch control signals for routing the optical signal.

21. A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over a plurality of outgoing links, the data payload having a given format and protocol, the system comprising

a route generator for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes,

an adder for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for the data payload and the header, the format and protocol of the data payload being independent of the format and protocol of the header,

a detector for detecting the multicast information at the given one of the nodes to determine switch control signals with reference to the multicast information as the data payload and the header propagate through the optical network,

an optical splitter for splitting the optical signal into a plurality of split optical signals,

a selector for selecting a plurality of local routes through the given one of the nodes in correspondence to the switch control signals,

an optical switch having input ports and output ports wherein each of the split optical signals couples to separate input ports, and wherein each of the outgoing links couples to corresponding output ports, and

a switch controller, coupled to the optical switch and responsive to the switch control signals, for switching the optical switch in response to the multicast information to optically couple the separate input ports with the corresponding output ports,

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier

frequencies occupying a frequency band above the baseband spectrum of the data payload,

the detector further comprising

a measurement device for concurrently measuring the header signals to produce a header selection signal,

a second selector, coupled to the measurement device, for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals, and

a processor, responsive to the incoming optical signal, for detecting the multicast information and for deleting the header signals and recovering only the data payload,

the system further comprising

a header generator, responsive to the selector, for determining a new active header signal conveying the multicast information, and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

22. A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the nodes multicasts over a plurality of outgoing links, the data payload having a given format and protocol, the system comprising

a route generator for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes,

an adder for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for the data payload and the header, the format and protocol of the data payload being independent of the format and protocol of the header,

a detector for detecting the multicast information at the nodes to determine switch control signals with reference to the multicast information as the data payload and the header propagate through the optical network,

an optical splitter for splitting the optical signal into a number of split optical signals corresponding to number of outgoing links,

an optical switch having input ports and output ports wherein each of the split optical signals couples to a corresponding one of the input ports,

an optical combiner coupled to predetermined ones of the output ports,

a plurality of multiplexers for coupling the optical combiner with the outgoing links, and

a switch controller, coupled to the optical switch and responsive to the switch control signals, for switching the optical switch in response to the multicast information to optically couple the corresponding input ports with corresponding output ports,

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload,

the detector further comprising

a measurement device for concurrently measuring the header signals to produce a header selection signal,

a second selector, coupled to the measurement device, for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals, and

a processor, responsive to the incoming optical signal, for detecting the multicast information and for deleting the header signals and recovering only the data payload,

the system further comprising

a header generator, responsive to the selector, for determining a new active header signal conveying the multicast information, and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

23. A system for multicasting a data payload through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the

nodes multicasts over two outgoing links, the data payload having a given format and protocol, the system comprising

a route generator for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes,

an adder for adding a header to the data payload and embedded in the same wavelength as the data payload prior to inputting the data payload at an input one of the nodes to produce an optical signal, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for the data payload and the header, the format and protocol of the data payload being independent of the format and protocol of the header,

a detector for detecting the multicast information at the nodes to determine two switch control signals with reference to the multicast information as the data payload and the header propagate through the optical network,

a one-by-two optical splitter for splitting the incoming optical signal into two split optical signals,

a four-by-four optical switch having four input ports and four output ports wherein the two split optical signals couple to the first and second input ports,

a first two-by-one optical combiner coupled to the first and second output ports,

a second two-by-one optical combiner coupled to the third and fourth output ports,

a first multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the first multiplexer is coupled to one of the two outgoing links,

a second multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the second multiplexer is coupled to the other of the two outgoing links, and

a switch controller, coupled to the optical switch and responsive to the switch control signals, for switching the optical switch in response to the multicast information to couple the first input port with the first output port and the second input port with the third output port,

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload,

the detector further comprising

a measurement device for concurrently measuring the header signals to produce a header selection signal,

a second selector, coupled to the measurement device, for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals, and

a processor, responsive to the incoming optical signal, for detecting the multicast information and for deleting the header signals and recovering only the data payload,

the system further comprising

a header generator, responsive to the selector, for determining a new active header signal conveying the multicast information, and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals.

24. The optical system as recited in claim 23 for multicasting a second incoming optical signal to the two outgoing links, the second input optical signal including a second header for conveying second multicasting information, the system further comprising

a second one-by-two optical splitter for splitting the second incoming optical signal into two split second optical signals,

wherein the second two-by-one optical combiner is coupled to the third and fourth output ports of the optical switch, and

wherein said switch controller, being responsive to the second header, switches the optical switch in response to the second multicast information to couple the third input port with the second output port and the fourth input port with the fourth output port.

25. A system for multicasting two data payloads through an optical network composed of a plurality of nodes interconnected by links wherein a given one of the

nodes multicasts over two outgoing links, each data payload having a given format and protocol, the system comprising

a route generator for generating and storing a local routing look-up table in each of the nodes, each local look-up table listing local addresses for determining alternative local routes through each of the nodes,

an adder for adding a header to each data payload and embedded in the same wavelength as each corresponding data payload prior to inputting each data payload at an input one of the nodes to produce two optical signals, the header having a format and protocol and conveying multicast information indicative of local routes through the given node for each data payload and each corresponding header, the format and protocol of each data payload being independent of the format and protocol of each corresponding header,

a first demultiplexer for detecting the first optical signal,

a second demultiplexer for detecting the second optical signal,

a first one-by-two optical splitter, coupled to the first demultiplexer, for splitting the first optical signal into two split first optical signals,

a second one-by-two optical splitter, coupled to the second demultiplexer, for splitting the second optical signal into two split second optical signals,

a detector for detecting the multicast information at the nodes to determine four switch control signals with reference to the multicast information as each of the data payloads and the corresponding headers propagate through the optical network,

a first four-by-four optical switch having four input ports and four output ports wherein the first split optical signals couple to the first and second input ports,

a second four-by-four optical switch having four input ports and four output ports wherein the second split optical signals couple to the first and second input ports,

a first two-by-one optical combiner coupled to the first and second output ports of the first optical switch,

a second two-by-one optical combiner coupled to the third and fourth output ports of the first optical switch,

a third two-by-one optical combiner coupled to the first and second output ports of the second optical switch,

a fourth two-by-one optical combiner coupled to the third and fourth output ports of the second optical switch,

a first multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the first multiplexer is coupled to one of the two outgoing links,

a second multiplexer coupled to the first optical combiner and the second optical combiner wherein the output of the second multiplexer is coupled to the other of the two outgoing links, and

a switch controller, coupled to the first optical switch and the second optical switch and responsive to the switch control signals, for switching the first optical switch and second optical switch in response to the multicast information to couple the first input port with the first output port of the first optical switch, the second input port with the third output port of the first optical switch, the first input port with the first

output port of the second optical switch, and the second input port with the third output port of the second optical switch,

wherein the header is composed of one or more header signals each being conveyed by a distinct sub-carrier frequency and arranged so that the highest detectable sub-carrier frequency corresponds to an active header signal, the plurality of sub-carrier frequencies occupying a frequency band above the baseband spectrum of the data payload,

the detector further comprising for each of the optical signals,

a measurement device for concurrently measuring the header signals to produce a header selection signal,

a second selector, coupled to the measurement device, for determining the active header signal as conveyed by the highest detectable sub-carrier frequency under control of the header selection signal to produce the switch control signals, and

a processor, responsive to the incoming optical signal, for detecting the multicast information and for deleting the header signals and recovering only the data payload,

the system further comprising

a header generator, responsive to the selector, for determining a new active header signal conveying the multicast information, and

means, responsive to the header generator, for inserting into the optical signal the new active header signal in place of the deleted header signals in each of the optical signals.